24. [25.] (Amended and canceled) A composite structure, comprising:

an aluminum-based substrate;

an anodization layer formed on at least a first portion of said substrate; and

a layer of boron carbide coated on said anodization layer overlying said first portion.

25. [26.] (Amended and canceled) The composite structure of Claim 24 [25], wherein said first portion of said substrate is roughened to a roughness of at least 2.5μm.

26. [27.] (Amended and canceled) The structure of Claim 24 [25], wherein said substrate has a composition selected from the group consisting of aluminum and aluminum alloys.

27. [28.] (Amended and canceled) The structure of Claim 26 [27], wherein said layer of boron carbide comprises between 14 to 30 wt% of carbon relative to boron.

REMARKS

Claims 1-6 and 8-23 remain in the application.

Applicant apologizes for misnumbering of the claims. The above amendments renumber all the claims, including canceled ones. It is noted that the renumbering does not agree with Examiner's because of the presence of two Claims 11 as filed. The description below of the rejections uses the third version of claim numbering.

The summary of the Disposition of Claims does not agree with the claim rejections. Claims 4 and 5 are summarized as begin objected to and not rejected. Such does not agree with the detailed rejection.

Applicants confirm their election of the method claims 1-23.

The Examiner rejects Claims 11, 12, 22, and 24 under 35 U.S.C. §112, ¶1 because of the use of atomic weight of carbon relative to boron. Although it is believed that the usage is clear in

view of the discussion on page 10, lines 7-9, the rejected claims have been amended into the form apparently suggested by the Examiner that the total atomic weight be recited in the denominator. The Examiner also rejects Claims 1-11 because of the lack of antecedent basis for "a substrate" in Claim 1. The basis of this rejection is not completely understood, but it is hoped that the requested amendment solves the problem.

The Examiner has rejected Claims 1-23 under 35 U.S.C. §112, ¶2 for indefiniteness because he contends the claimed roughness value is not adequately specified. The rejection of Claims 13-23 is not proper because no roughness value is specified, only that a roughening operation be performed. Claim 1 has been amended to include the more specific roughness value of a surface finish R_a, as supported on page 14, line 17.

The Examiner has rejected Claims 1-23 under 35 U.S.C. §103(a) as being obvious over Linke, Mizuhara, Ponnekanti, Reinhard, Raeder and Smithells. This rejection is traversed.

Linke of course describes, among other things, applying a boron carbide coating to a substrate for use in "fusion-relevant conditions". Experiments were performed in "high heat flux facilities." However, the invention is directed to a coating of boron carbide over aluminum. Linke does not mention aluminum-based substrates, and aluminum bodies, in view of aluminum's melting point of 660°C, are simply not feasible in fusion reactors or in the above 1000°K temperatures in which Linke expresses interest.

Mizuhara is irrelevant to the filed claims as properly interpreted. Claim 1 recites an aluminum-based member in the preamble. Claim 13 recites an aluminum-based member in the first step. This term is alternatively defined on page 19, lines 16-20. The second definition has been amended into the body of Claims 1 and 13. Mizuhara is concerned with ceramic-to-metal seals, particularly oxide ceramic-to-metal seals. He nowhere mentions either aluminum-based materials, of the sort described the filed application and now as explicitly recited in the claims, and he nowhere mentions boron carbide. His principal oxide of interest is alumina, which is not a so-defined aluminum-based material. It is noted that the brazing temperatures plotted in FIG. 6 of Mizuhara are all above the melting point of aluminum, hardly indicating recommended

processing conditions for an aluminum substrate.

The Examiner's references to Mizuhara's "active brazing process" and to his "wetting ... accomplished by the chemical reaction of the active element with the ceramic" are not understood. The present invention includes depositing boron carbide on aluminum, possibly with an intervening anodization layer. Mizuhara simply does not suggest anything of this sort. At best, his alumina member is somewhat analogous to an anodized surface layer, but still differs in important details.

It is further pointed out the maximum value of surface roughness for the oxide quoted in Mizuhara's TABLE 3 is 1.17μm, which fails to conform to the required minimum value of 2.5μm of Claim 1.

The relevance of Ponnekanti to the claimed invention is not clear. Ponnekanti describes several failure mechanisms of anodized aluminum exposed to a fluorine plasma. His conclusion that fluorine precipates at defects in the underlying aluminum has no clear relevance to coating boron carbide on either free aluminum or anodized aluminum. In fact, once Ponnekanti's aluminum or anodized aluminum is coated with boron carbide, it is doubtful that his stated mechanisms are operative.

Reinhart enjoys only marginally greater relevance. Although he discusses roughening a substrate prior to bonding, he is concerned only with adhesive bonding and the roughening is directed only to the adhesive bonding of composites rather than metallic materials. No suggestion exists that boron carbide be adhesively bonded. Reinhart simply teaches nothing about depositing boron carbide over pure or anodized aluminum. Even the teaching of surface roughening appears to be contrasted with the use of the phosphoric acid anodization (PAA) treatment of aluminum. Claim 1 requires roughening the aluminum prior to anodization. Rienhart even very broadly interpreted could apply only to roughening after anodization and prior to adhesive bonding of the composite.

Raeder discusses grinding and polishing of glass and glass ceramics. Its relevance to aluminum and anodization is not clear. Furthermore, Claim 1 refers to roughening a surface, not

polishing it as done by Raeder. Raeder does not address intentional roughening. His grinding is directed to shaping. Accordingly, Raeder also is irrelevant.

Smithells discloses compositions of several high alloy steels and nickel and cobalt alloys. Although some of them contain small amount of aluminum, they do not conform to the defined aluminum-based materials. The Examiner has not cited any teaching of Smithells.

The art thus fails to teach the combination of a boron carbide coating and an aluminum-based substrate and further fails to teach the combination of a boron carbide coating and an anodized aluminum substrate. The art has even failed to suggest the advantage of roughening the aluminum prior to anodization. It is not disputed that some art teaches boron carbide coatings and other art teaches aluminum members, perhaps anodized. It is disputed that the combination is in anyway suggested in the art. The test for obviousness is not that the prior art can be combined but that there is a suggestion in the prior art for making the combination.

Claim 18 recites a selectively placed anodization under the boron carbide. The Examiner's sole reference to this feature was a failure mechanism, hardly a suggestion for making the combination.

Art cited in a recent European Search Report is herewith submitted.

Applicants' attorney desires to personally interview the Examiner in Arlington after receipt of this response and will be contacting the Examiner.

In view of the above amendments and remarks, reconsideration and allowance of all claims are respectfully requested. If the Examiner believes that a telephone interview would be helpful, he is invited to contact the undersigned attorney at the listed telephone number, which is on California time.

Respectfully submitted,

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